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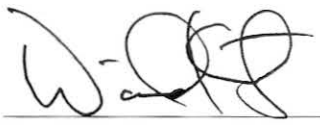

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Abstract

Title of Thesis: PERCEIVED SOCIAL SUPPORT AND MARKERS OF HEART FAILURE SEVERITY

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Introduction. Heart failure is a symptomatic condition that occurs when the heart is unable to pump enough blood and oxygen to adequately supply other organs in the body (CDC, 2010). Although commonly associated with demographic and medical risk factors, psychosocial variables such as social support and depression have also been shown to influence the development and progression of heart failure (Everson-Rose & Lewis, 2005; MacMahon & Lip, 2002). The present study examined the relationship between various components of functional social support as assessed by the Interpersonal Support Evaluation List (ISEL-12) — including tangible, appraisal, and belonging resources — and three recognized markers of heart failure severity (i.e., functional status as measured by distance walked on the Six Minute Walk Test (6MWT), self-reported symptoms as indicated by the Kansas City Cardiomyopathy Questionnaire (KCCQ), and levels of the biomarker BNP). *Methods.* Ninety-seven heart failure patients completed psychosocial and physical health related questionnaires, participated in functional assessments, and supplied a blood sample. *Results.* Univariate and multivariate analyses revealed that, independent of recognized predictors such as age, body mass index, gender, marital status, smoking status, and depression, greater appraisal support as measured by the ISEL Appraisal Subscale significantly predicted greater distance walked on the 6MWT ($\beta = .24$, $p = .03$), explaining 5 percent of the variance ($\Delta R^2 = .05$, $\Delta F\ (1, 78) = 4.85$,

p = .01) and fewer reported symptoms on the KCCQ Overall Summary Score (β = .19, p = .02), accounting for 3 percent of the variance (ΔR^2 = .03, ΔF (1, 88) = 5.29, p = .02).

Conclusions. These findings suggest that appraisal support may be an important function of social support associated with heart failure severity, potentially working through behavioral, biological, and psychological processes to reduce the impact of disease morbidity.

PERCEIVED SOCIAL SUPPORT AND

MARKERS OF HEART FAILURE SEVERITY

By

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Masters Thesis submitted to the faculty of the

Department of Medical and Clinical Psychology

Graduate Program of the

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Introduction

Heart failure is a symptomatic condition that occurs when the heart is unable to pump enough blood and oxygen to adequately supply other organs in the body (CDC, 2010). Approximately 5.8 million adults suffer from heart failure in the United States with 670,000 new cases diagnosed annually (AHA, 2010). The National Center for Health Statistics reports that one in eight deaths are attributable to heart failure (Lloyd-Jones et al., 2010). For those patients fortunate enough to evade mortality, heart failure can generate significant disability and deficits to quality of life due to symptoms associated with the condition (e.g., shortness of breath, chest pain) (Westlake et al., 2002). Within military populations, nearly 5 percent of patients treated at Veterans Affairs (VA) Medical Centers have a primary diagnosis of heart failure with over 42,000 veterans hospitalized annually (Veterans Health Administration, 2007). Accordingly, heart failure remains a major contributor to health care expenses for both the United States and the Department of Defense, with an estimated $39.2 billion spent on direct and indirect costs in 2010 (Lloyd-Jones et al., 2010).

Heart failure can result from a variety of cardiovascular malfunctions. In addition to the physiological pathways described below, a number of psychological and social variables have been shown to influence the development and progression of heart failure (Everson-Rose & Lewis, 2005; MacMahon & Lip, 2002). Importantly, depression and lack of social support have been shown to significantly contribute to the progression of heart failure (Luttik, Jaarsma, Moser, Sanderman, & van Veldhuisen, 2005; Rutledge, Reis, Linke, Greenberg, & Mills, 2006; Williams et al., 2002).

The present study investigates the role of social support, or the availability

of various resources provided by social relationships, as a factor influencing aspects of heart failure symptoms and patient functional status. First, heart failure will be defined and its etiology will be outlined including risk factors. Next, social support and conceptual models explaining the link between social support and health will be presented. Literature related to psychosocial risk factors and cardiovascular disease outcomes, specifically involving heart failure, will be covered in formulating the study's aims and hypotheses.

Heart Failure

Definition and etiology. According to the American College of Cardiology and the American Heart Association, heart failure is defined as a "complex clinical syndrome that can result from any structural or functional cardiac disorder that impairs the ability of the ventricle to fill with or eject blood" (Hunt et al., 2005, pp. e158-e160). In a healthy heart, deoxygenated blood enters from the body through the superior and inferior vena cava, filling the right atrium. Blood is then released from this upper chamber into the right ventricle where it is propelled into the lungs through the pulmonary arteries (NHLBI, 2001). Once becoming oxygenated in the lungs, blood returns to the heart through the pulmonary veins into the left atrium. After being pumped from the atrium into the left ventricle, oxygen-rich blood is disseminated to the rest of the body through the aorta (NHLBI, 2001).

A healthy heart has the capacity to expel approximately 60 percent of the blood from the ventricles to allow oxygenated blood to reach locations throughout the body (NHLBI, 2001). A damaged heart, however, struggles to pump the blood necessary to adequately maintain bodily systems. For instance, a damaged heart may only be able to

pump less than 40 percent of the blood from the ventricles. This inadequacy is referred to a systolic dysfunction, or systolic heart failure, and emerges as a result of impaired contractility or pressure overload in the cardiovascular system (Chatterjee & Fifer, 2011). Adverse conditions such as damaged or abnormal heart muscle cells, the development of excess fibrous tissue, chronic volume overload, aortic valve narrowing, and uncontrolled hypertension contribute to weaken contractility and overloaded pressure on the heart that results in the inadequate percentage of blood ejected from the ventricles, or systolic dysfunction. The most common source of systolic heart failure is cardiac damage resulting from coronary artery disease, especially impairment caused by a myocardial infarction (Chatterjee & Fifer, 2011).

Alternatively, a damaged heart may sometimes be able to pump a percentage of blood similar to a healthy heart; however, the amount of blood expelled from the ventricles may be lower than normal. This type of dysfunction, commonly referred to as diastolic heart failure, develops from cardiac abnormalities that restrict the amount of blood entering the heart for normal filling (Chatterjee & Fifer, 2011). Impaired diastolic filling occurs as a result of cardiovascular disorders such as left ventricular hypertrophy, cardiomyopathies, myocardial fibrosis, myocardial ischemia, and pericardial constriction (Chatterjee & Fifer, 2011).

When the heart is unable to contract properly due to damage, this adaptive muscle employs compensatory strategies in an attempt to allow more oxygenated blood to reach peripheral systems (HFA of the ESC, 2007). The heart may beat faster to keep the blood moving, stretch to expand in size allowing for the organ to hold more blood, or develop thicker muscle to help pump more blood with each beat. Over time these changes put

more stress on the heart and body resulting in clinical symptoms such as fatigue, shortness of breath, peripheral edema, and chest discomfort (Chatterjee & Fifer, 2011).

In both systolic and diastolic dysfunction, a damaged heart struggles to circulate blood and oxygen to organs throughout the body either due to the diminished percentage able to be expelled from the ventricles or limited blood available to be pumped to periphery locations (Chatterjee & Fifer, 2011). This failure of the heart to supply bodily systems with sufficient resources usually represents the end stage of cardiovascular disorders. Although heart failure can result from either systolic or diastolic dysfunction, the present investigation focuses primarily on those individuals who are unable to pump more than 40 percent of blood from the left ventricle as evidence suggests that persons with this type of heart failure may benefit most from interventions due to the etiology of their conditions. Specifically, persons with left ventricular heart failure may benefit from psychosocial interventions targeting modifiable cardiovascular risk factors such as health behaviors, psychological stress, and social support resources (Das & O'Keefe, 2006).

Diagnosing heart failure. Because heart failure is a complex clinical syndrome that can result from a variety of structural or functional abnormalities, no single diagnostic measure exists for heart failure. Instead, physicians routinely rely upon an individual's functional status, reported symptoms, and observed physiological markers to determine the existence of heart failure (Hunt et al., 2005).

Functional status. Functional status refers to a person's capacity to participate in activities of daily living and engage in social role activities. A patient's functional status is often assessed through reported impairment or the behavioral performance of actions related to daily living (Hunt et al., 2005). One well-adopted measurement of functional

status for heart failure patients is the Six Minute Walk Test (6MWT) that assesses the distance a person can walk in six minutes. Safe and easy to administer, the Six Minute Walk Test also closely resembles demands that patients encounter in daily life (ATS, 2002). Overall, the 6MWT provides an evaluation of global and integrated responses of pulmonary, cardiovascular, and neuromuscular systems during exercise, and, therefore, represents a practical measure of functionality in cardiovascular patients (ATS, 2002).

Self-reported symptoms. Patient-reported symptoms such as fatigue, shortness of breath, peripheral edema, and chest discomfort provide indication to clinical providers that the heart may be overworking to compensate for cardiac damage (Hunt et al., 2005). To assess the presence and severity of cardiac-related symptoms, providers frequently rely on medical interviews and self-reported measures. One widely adopted, disease-specific instrument used to provide a subjective appraisal of secondary effects related to heart failure is the Kansas City Cardiomyopathy Questionnaire (KCCQ), which is a validated, self-administered questionnaire that quantifies physical limitations, symptoms, self-efficacy, social interference, and quality of life (Green, Porter, Bresnahan, Spertus, 2000).

Physiological measures / biomarkers. Doctors also use physiological evidence to determine the presence of heart failure. Measures such as echocardiograms, stress tests, and biomakers of heart failure severity can objectively measure adverse cardiovascular conditions (Hunt et al., 2005). One widely recognized biomarker of heart failure severity is ß-natriuretic peptide (BNP), a 32 amino acid polypeptide released from the ventricles of the heart in response to excessive stretching. Cardiac myocytes secrete BNP as a means of countering effects associated with increased myocardial stretch due to high

pressure filling, increased arterial pressure, or cardiac dilation (Miller, Redfield, & McConnell, 2007). As such, BNP is routinely used in medical and research settings as an objective indicator of heart failure severity (Dao et al., 2001; Miller et al., 2007; Yamamoto et al., 1996). Although clinicians and researchers acknowledge the utility of BNP as a valuable biomarker for the diagnosis of heart failure, some evidence suggests that BNP concentrations may exhibit poor sensitivity and specificity for cardiac dysfunction and demonstrate within-person variability over time despite other stable clinical indicators (Hetmanski, Sparrow, Curtis, Cowley, 2000; Takeda, Takeda, Suzuki, & Kimura, 2009).

Classifying heart failure severity. Physicians also commonly use the New York Heart Association (NYHA) classification system as a means of categorizing heart failure severity and prognosis. This hierarchy assigns patients to varying classes of heart failure depending on their reported symptoms and functional impairment. As illustrated in Table 1, higher classes of heart failure represent greater limitations in physical activity and, therefore, more severe cardiac conditions (Hunt et al., 2005).

Table 1

New York Heart Association Classification System (AHA, 2011)

Class		***Limitations***	***Disability***
I	*Mild*	*No limitation of physical activity*	*Ordinary physical activity does not cause undue fatigue, palpitation, dyspnea, or anginal pain*
II	*Mild*	*Slight limitation of physical activity*	*Ordinary physical activity results in fatigue, palpitation, dyspnea, or anginal pain*
III	*Moderate*	*Marked limitation of physical activity*	*Less than ordinary activity causes fatigue, palpitation, dyspnea, or anginal pain*
IV	*Severe*	*Unable to carry out any physical activity without discomfort*	*Symptoms of heart failure present even at rest; If any physical activity is undertaken, discomfort increases*

Heart failure risk factors. A number of risk factors have been identified for the development and progression of heart failure. Demographic variables such as increasing age and male gender, for example, have been consistently linked to a higher risk for heart failure likely attributable to a greater prevalence of coronary heart disease among these populations (Listerman, Huang, Geisberg, & Butler, 2007). Similarly, clinical risk factors such as hypertension and diabetes have been shown to be predictive of heart failure independent of other known risk factors (He et al., 2001; van Melle et al., 2010). In a prospective examination of 5,143 patients, hypertension was found to be the most common risk factor for congestive heart failure, preceding the condition in 91 percent of patients sampled (Levy, Larson, Vasan, Kannel, & Ho, 1996). Similarly, patients with diabetes have been shown to be more likely to develop congestive heart failure than nondiabetic patients matched for age and gender (Nichols, Gullion, Koro, Ephross, & Brown, 2004). Adverse cardiac events such as a myocardial infarction, or heart attack, can further interrupt appropriate functioning of the heart, resulting in cardiovascular damage that increases one's risk for heart failure (Levy et al., 1996).

Additionally, poor health behaviors such as limited physical activity, poor nutrition, and smoking have been identified as risk factors for heart failure (Lloyd-Jones et al., 2010). For example, evidence suggests that active smokers exhibit a 30 percent greater risk for mortality due to heart failure as compared with former smokers (Lightwood, Fleischmann, & Glantz, 2001). Likewise, each one unit increment of BMI independently contributes to 5 percent and 7 percent risk of heart failure in men and women, respectively, in community-based samples (Kenchaiah et al., 2002).

Psychosocial risk factors. Researchers have long acknowledged the contribution

of psychosocial variables to the onset and outcome of cardiovascular conditions. In several early case studies, for example, psychological stress was suggested to be a precipitating factor for heart failure. For example, Chambers and Reiser (1953) determined that emotional stress, as assessed by physician interviews with patients and family members, was a precipitating factor in 76 percent of the observed hospital admissions for heart failure in a small sample of 25 patients admitted to Cincinnati General Hospital. More contemporary investigations affirm that psychological stress is significantly associated with an increased risk for morbidity and mortality in cardiac patients through direct pathophysiological effects (Everson-Rose & Lewis, 2005). Sudden emotional stress has even been shown to induce severe, reversible left ventricular dysfunction in patients without coronary disease, suggesting that the exaggerated sympathetic stimulation brought about by psychological stress may be a central mechanism in the development of heart failure (Wittstein et al., 2005).

Depression and heart failure. Depression, in particular, has received considerable attention as risk factor for heart failure (Kop, Synowski, & Gottlieb, 2011; Rutledge et al., 2006). Depressive symptoms are extremely common among patients presenting with heart failure likely due to the disability and deficits to quality of life associated with the condition (Kop et al., 2011). Specifically, greater depressive symptoms have been significantly correlated with increased rates of mortality, clinical events, hospital readmission, and general health care use among persons diagnosed with heart failure (Rutledge et al., 2006). For example, Williams and colleagues (2002) found that women within an elderly, community sample who reported depressive symptoms were at greater risk than those patients not endorsing depressive symptoms of developing heart failure

over a 14-year prospective investigation. A comprehensive meta-analysis conducted by Nicholson, Kuper, and Hemingway (2006) showed that, among 54 observational studies, depression was not only predictive of recurrent cardiac events in patients with known cardiovascular disease, but was also consistently predictive of incident cardiac events in individuals without cardiovascular conditions. Moreover, depression has been implicated as a significant risk factor for functional decline and mortality among heart failure patients, comparable to traditional risk factors such as elevated cholesterol and hypertension (Kop, Synowski, & Gottlieb, 2011; Jiang et al., 2001; Sherwood et al., 2007; Vaccarino, Kasl, Abramson, & Krumholz, 2001).

Social support and cardiovascular outcomes. In contrast to risk factors, social support is seen as a protective psychosocial variable that appears to buffer against many of the negative outcomes associated with cardiovascular conditions (Everson-Rose & Lewis, 2005; MacMahon & Lip, 2002). For instance, the presence of social networks has been associated with a reduced risk for coronary heart disease and lower rates of mortality among women with suspected cardiovascular disorders (Rutledge et al., 2004). Also, more advanced atherosclerosis progression has been found among persons lacking interpersonal relationships and emotional support (Wang et al., 2005). Experimental evidence demonstrated that the presence of a supportive ally could have a protective influence on health such as reducing cardiovascular reactivity during acute stress (Christenfeld & Gerin, 2000). Overall, social support has been shown to significantly influence the onset and progression of coronary heart disease both among healthy and diseased populations (Eng, Rimm, Fitzmaurice, & Kawachi, 2002; Lett et al., 2005; Wang, Mittleman, & Orth-Gomer, 2005).

Social Support

Social support is a broad term that refers to a variety of means by which social relationships influence health and well being (Cohen, Underwood, & Gottlieb, 2000). For example, social connections establish an infrastructure upon which emotional, informational, instrumental, or companionship resources can be provided or exchanged in response to the needs of others. In this manner, the term social support pertains to the actual or perceived resources afforded by formal and informal helping relationships (Cohen et al., 2000). Likewise, social relationships may influence health by encouraging participation in supportive social groups. The construct of social support, therefore, is often defined conceptually or operationally in terms of the structure of one's social relationships or the functions rendered by social contacts (House & Kahn, 1985). Although interrelated, the structure and function of social relations constitute distinct constructs that describe and measure unique facets of social support.

Types of social support.

Structural social support. Structural social support refers to the support generated by "the existence of and interconnections between social ties" (Cohen & Syme, 1985, p. 11). Structural aspects of social support include constructs of both social integration / isolation and social networks that provide a sense of the breadth and depth of one's social system. The structure of social support focuses on the size, density, complexity, symmetry, and stability of social relationships (Cohen et al., 2000). Interpersonal resources from structural social support are garnered through participation in and contact with social others for the purpose of interaction without the exchange of explicit help or support (Cohen, et al., 2000). This multidimensional construct is often measured by

examining the number of recognized social positions or identities persons hold as well as their frequency of social activities and perceived embededness within a social structure (Cohen et al., 2000). Generally considered to capture objective characteristics of social relations, measures of structural support are useful to assess qualities of stability, predictability, belongingness, and control afforded by social contact and group membership (Cohen & Syme, 1985).

Functional social support. Functional social support refers to the emotional, informational, instrumental, and companionship resources furnished by social contacts (Cohen et al., 2000). Focused on the supportive functions of interpersonal relationships, functional social support is often defined by psychological representations that an individual constructs of support systems based on the subjective appraisal of available resources (Cohen & Syme, 1985). Hence, functional support measures commonly examine perceived support assets in addition to resources actually received in the context of formal and informal helping relationships (Cohen et al., 2000).

According to Cohen and colleagues (2000), social relationships can serve many supportive functions to include the provision of emotional, informational, instrumental and companionship resources in response to need. Emotional support, for example, permits the expression of feelings and reception of acceptance by others necessary for altering threat evaluation and enhancing self-esteem. Informational support, also referred to as appraisal support, describes the availability of valuable sources of information and guidance needed to obtain desired services or effectively cope with life events (Cohen et al., 2000). Instrumental or tangible support denotes resources directed toward resolving practical problems such as providing monetary aid, transportation, or daily care

assistance. Companionship support, which represents a sense of personal belonging, refers to the accessibility of others with whom to engage in social activities for mood enhancing or problem distraction benefits (Cohen et al., 2000). Although researchers have explored both the structure and function of social support, functional qualities of social relationships are commonly considered as better predictors of health and health behaviors (Cohen & Syme, 1985).

Social Support and Health

Whether arising from the structure or function of social relations, social support has historically been linked to a variety of health outcomes (Brady & Helgeson, 1999; Cohen & Syme, 1985; Theorell et al., 1995). In addition, the absence of social support has been identified as a risk factor for psychological well being, the onset or exacerbation of illness, and even mortality (Avison & Gotlib, 1994; Cohen, Doyle, Skoner, Rabin, Gwaltney, 1997; Holt-Lunstad, Smith, & Layton, 2010). For example, in the classic epidemiological study conducted by Berkman and Syme (1979) examining 2,229 males and 2,496 females, researchers found that socially isolated persons — as determined by four sources of social contact including marital status, contact with significant others, church membership, as well as informal and formal group associations — were more likely to die from both all-cause and cardiac conditions as compared with those with extensive contacts. Moreover, relationships between social connections and mortality were found across all age groups and to be independent of self-reported physical health status, socioeconomic status, and health practices including smoking, alcoholic beverage consumption, obesity, physical activity, and utilization of preventative health services over a nine-year period (Berkman & Syme, 1979).

Conceptual models of social support. Given that existing literature largely confirms a relationship between social support and health, contemporary research has been directed toward focus on the processes through which social support may exert a beneficial influence. Perhaps the most widely cited conceptual framework for the effects of social support on health is provided by Cohen and Wills (1985) who propose two models to explain the link between social support and well being termed the *main effect* and *stress buffering hypotheses.*

The *main effect hypothesis* posits that social relationships directly impact health in that social resources enact beneficial effects irrespective of the presence or absence of stress (Cohen & Wills, 1985). Social relations may expose individuals to social pressures that affect normative health behaviors, provide access to services or information, or enhance positive psychological states. Integration within a social network presumably offers perceived stability, predictability, belongingness, and recognition of self-worth that can benefit well being and bolster physical and psychological health (Cohen et al, 2000). One example of a positive main effect enacted by social support is the favorable impact on medical compliance. Meta-analytic summaries reflecting 51 empirical journal articles suggest that individuals who are married are 1.27 times more likely to adhere to recommended medical treatments as compared with those persons who are single (DiMatteo, 2004). However, social influences may not always be beneficial for health. For instance, some social relationships have been shown to negatively impact health behaviors as has been observed in the spread of obesity. In a hallmark investigation evaluating an interconnected social network of 12,067 individuals, Christakis and Fowler (2007) found that an individual was 57 percent more likely to become obese over time if

his or her friend also became obese during the same given interval of time.

In contrast, the *stress buffering hypothesis* contends that social relationships influence health through the prevention or lessening of responses to stress. Cohen and Wills (1985) describe that "support 'buffers' (protects) persons from the potentially pathogenic influence of stressful events," thereby safeguarding or augmenting health (p. 310). According to the stress buffering model, social support resources intervene in the causal chain linking stress and health through alterations in stress appraisal (i.e., shifts in the perception of threat or coping resources) and adjustments to emotional, physiologic, and behavioral responses (Cohen & Wills, 1985; Cohen et al., 2000). An application of this phenomenon has been observed among breast cancer survivors reporting decreased bodily pain and ameliorated physical activity restrictions due to positive reinterpretation stimulated by partner emotional support and oncologist informational support (Brady & Helgeson, 1999). Specifically, Brady and Helgeson (1999) noted that functional and pain symptoms, measured using the Short Form-36 Quality of Life Scale, improved over time among females who reported partner and oncologist support following a recurrence of breast cancer.

Potential pathways linking social support and health. Synthesizing the theoretical and empirical work of earlier researchers, Uchino (2006) proposed a conceptual model of potential pathways linking social support and health. The model suggests three routes through which social resources impact disease morbidity and mortality: behavioral, psychological, and biological processes.

Behavioral processes, as illustrated in Figure 1, are one pathway through which social relationships exert influence over health. As previously described, social support has been shown to have demonstrated effects on health promotion in that the presence of others can facilitate engagement in healthy behaviors such as exercise, nutrition, and smoking cessation (Mermelstein, Cohen, Lichtenstein, Baer, & Kamarck, 1986; Plante et al., 2010; Verheijden, Bakx, van Weel, Koelen, & van Staveren, 2005). Supportive social relationships also promote compliance with medical regimens (DiMatteo, 2004). Of course, social ties may detrimentally encourage unhealthy behaviors or establish maladaptive norms that degrade health as formerly noted in the case of obesity (Christakis & Fowler, 2007).

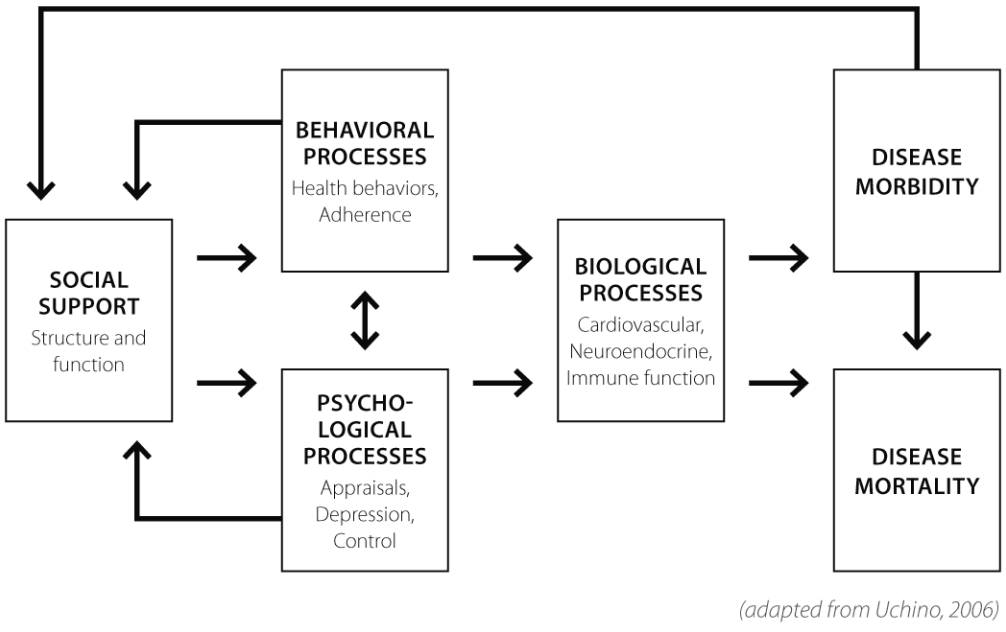

Figure 1. Pathways linking social support and health (Uchino, 2006)

Psychological processes encompass a second pathway by which social support impacts health via cognitive appraisal, perceived control, and affective states (Uchino, 2006). Accumulating evidence has long supported the association between social support and mental health (Avison & Gotlib, 1994). Social connections have been shown to enhance mood, reinforce self-esteem, and introduce adaptive coping resources for stress (Spiegel, Bloom, & Yalom, 1981). In fact, the use of adaptive appraisal strategies — specifically, positive reinterpretation — has been shown to predict better physical health outcomes in individuals with chronic conditions (Brady & Helgeson, 1999). Behavioral and psychological pathways share a reciprocal influence in that the appraisal of stress and coping resources often affect the practice of health behaviors or willingness to seek supportive relationships (Uchino, 2006).

A third pathway mediating the relationship between social support and health (see Figure 1) consists of biological processes involving physiologic changes in immune, neuroendocrine, and cardiovascular functions. For instance, strong associations have been noted between social support and immune functioning to include greater resistance to upper respiratory illness when integrated within diverse social networks (Cohen et al., 1997). Oxytocin, a neuroendocrine hormone with demonstrated anxiolytic effects, has, likewise, been implicated as possible underlying mechanism for explaining the health promotive effects of social support. Research in animal models suggests that the peripheral and central release of oxytocin in bodily systems may ameliorate stress activity associated with the hypothalamic-pituitary-adrenal (HPA) axis (Heinrichs, Baumgartner, Kirschbaum, & Ehlert, 2003). However, the majority of research exploring the relationship been social support and health via biological pathways has focused on the

cardiovascular system. As previously reviewed, social support has been shown to predict the onset and progression of cardiovascular disorders both among healthy and diseased populations with the presence of social relationships associated with a reduced risk for morbidity and mortality (Eng et al., 2002; Lett et al., 2005; Rutledge et al., 2004; Wang et al., 2005). Although explored amongst an assortment of cardiovascular domains, the present review will focus primarily on social support as has been examined with respect to heart failure outcomes — specifically, hospital readmission, quality of life, and mortality.

Social Support and Heart Failure Outcomes

Hospital readmission. A number of studies have investigated the influence of social support on hospital readmission among heart failure patients. Prospective evaluations of patients diagnosed with heart failure reveal that poor social support systems are a significant predictor of hospital readmission, even after controlling for medical risk factors (Chin & Goldman, 1997; Tsuchihashi-Makaya, Kato, Chishaki, Takeshita, & Tsutsui, 2009; Vinson, Rich, Sperry, Shah, & McNamara, 1990). Upon examining 292 heart failure patients in the year following initial hospitalization, Krumholz and colleagues (1998) found that the absence of emotional support, as assessed via reported number of social contacts with whom one has access to discuss personal problems, significantly predicted adverse cardiovascular events. Retrospective reviews of medical records have also identified supportive relationships as a preventative variable in hospital readmission (Happ, Naylor, & Roe-Prior, 1997). Informal social support bestowed by caregivers has, likewise, been shown to lessen the risk of hospital readmission (Schwartz and Elman, 2003). Regarding the duration of hospitalization,

Wright and colleagues (2001) found that the existence of social problems and isolated living conditions were associated with hospitalization that was longer than average. Despite the abundance of findings favoring the significant influence of social support on hospital readmission, Bennett, Pressler, Hays, Firestine, & Huster (1997) found that social support was not a significant predictor of hospitalization among 62 patients diagnosed with heart failure. The researchers, however, acknowledge that this nonsignificant outcome may be potentially confounded by the perceived availability of social support afforded by marital status that was not included in analyses.

Quality of life. Conflicting evidence has emerged for the influence of social support on health-related quality of life among persons diagnosed with heart failure. For the majority of research exploring quality of life within cardiovascular conditions, the term "quality of life" refers to the "general health, physical functioning, physical symptoms and toxicity, emotional functioning, cognitive functioning, role functioning, social well-being and functioning, sexual functioning and existential issues" of persons diagnosed with illness (Fayers & Machin, 2007, p. 4). Bennet and colleagues (2001), for instance, found that levels of social support assessed at baseline during heart failure hospitalization did not predict health-related quality of life 12 months following. The researchers did, however, discover that increases in perceived social support over 12 months significantly predicted improvements in health-related quality of life as measured by the Chronic Heart Failure Questionnaire. Westlake et al. (2002) similarly found the absence of a relationship between structural or functional social support and health-related quality of life in a sample of patients undergoing evaluation for heart transplantation. Nevertheless, greater emotional support has been linked to increases

in positive affect and life satisfaction in older women with heart failure while augmented tangible support has been associated with reduced negative affect (Friedman & King, 1994). With respect to physical symptoms, research suggests that emotional and tangible support do not buffer against symptom severity (Friedman & King, 1994), although perceptions of social support have been negatively correlated with the impact of physical symptoms on quality of life among persons recently hospitalized for heart failure (Bennett, Baker, Huster, 1998).

Mortality. Of particular concern are investigations suggesting an empirical link between social support and an increased risk of mortality for heart failure patients. Numerous studies demonstrate that social isolation and the absence of a supportive social environment are predictive of future mortality in heart failure patients, independent of demographic variables and clinical predictors (Chin & Goldman, 1997; Friedmann et al., 2006; Krumholz et al., 1998). For example, Murberg and Bru (2001) found perceived social support and perceived social isolation to be significant predictors of mortality among 119 clinically stable patients with symptomatic heart failure after controlling for depressive symptoms, condition severity, functional status, and age. Multivariable analyses conducted by Chin and Goldman (1997) further revealed that being unmarried (or never married) was an independent correlate of hospital readmission or death among 257 persons diagnosed with heart failure. Coyne and colleagues (2001) extended these findings through interview and observational measures of marital quality gathered from 189 heart failure patients and their spouses. These researchers found that marital quality predicted patient survival over 4 years, with a stronger association between marital functioning and survival among female patients as compared with male. "Indeed,

7 of the 8 female patients with the poorest marital quality died within 2 years of the initial assessment" (Coyne et al., 2001, p. 528). The lack of a social support network has also been shown to be a significant predictor of one-year mortality after acute myocardial infarction — a common cause of heart failure — comparable to classic risk factors such as elevated cholesterol levels, tobacco use, and hypertension (Mookadam & Arthur, 2004).

Diagnostic measures of heart failure severity. While the majority of research investigating social support and heart failure has been directed toward medical outcomes such as hospital readmission, quality of life, and mortality, limited attention has been aimed at examining the association between social relationships and diagnostic measures of heart failure severity. A review of literature relating to social support and heart failure outcomes revealed that, although regularly applied as a diagnostic measure in clinical practice, functional exercise capacity as measured by a walk test was rarely included as an outcome variable when examining the influence of psychosocial variables. Of the investigations incorporating both a measure of functional capacity and social support, evidence is contradictory, implying a significant positive correlation or no relationship between perceived social support and physical functioning as measured by the Six Minute Walk Test (Corvera-Tindel, Doering, Roper, & Dracup, 2009; Rosen, Contrada, Gorkin, & Kostis, 1997). Similarly, objective biomarkers shown to assist in diagnostic accuracy have also been overlooked in the literature when exploring the relationship between social support and heart failure severity. Although no investigations were found examining the influence of social relationships on objective indicators of heart failure severity, biomarkers such as BNP have been shown to be significantly associated with

other psychosocial variables to include depression (Song et al., 2010). Contrary to functional capacity and objective biomarkers, the subjective health status or quality of life for heart failure patients, as previously reviewed, has been more readily examined throughout the cardiovascular literature. Accumulating research suggested that social support was predominantly associated with overall perceived health and better quality of life among persons diagnosed with heart failure when measured using the KCCQ (Clark, Tu, Weiner, & Murray, 2003; Luttik, 2005).

Summary and Study Rationale

Overall, research suggests that low levels of social support are associated with an increased risk for cardiovascular events, although evidence remains inconclusive about what types of support are most closely linked with clinical outcomes (Lett et al., 2005). The present investigation aims to examine relationships between various components of social support and distinct markers of heart failure severity. Specifically, we explored three functions of perceived social support to include tangible, appraisal, and belonging resources as well as the overall perceived social support construct to determine what relationships, if any, these variables shared with three recognized markers of heart failure severity (i.e., functional status, reported symptoms, and a known biomarker). A conceptual model of the present investigation is depicted in Figure 2.

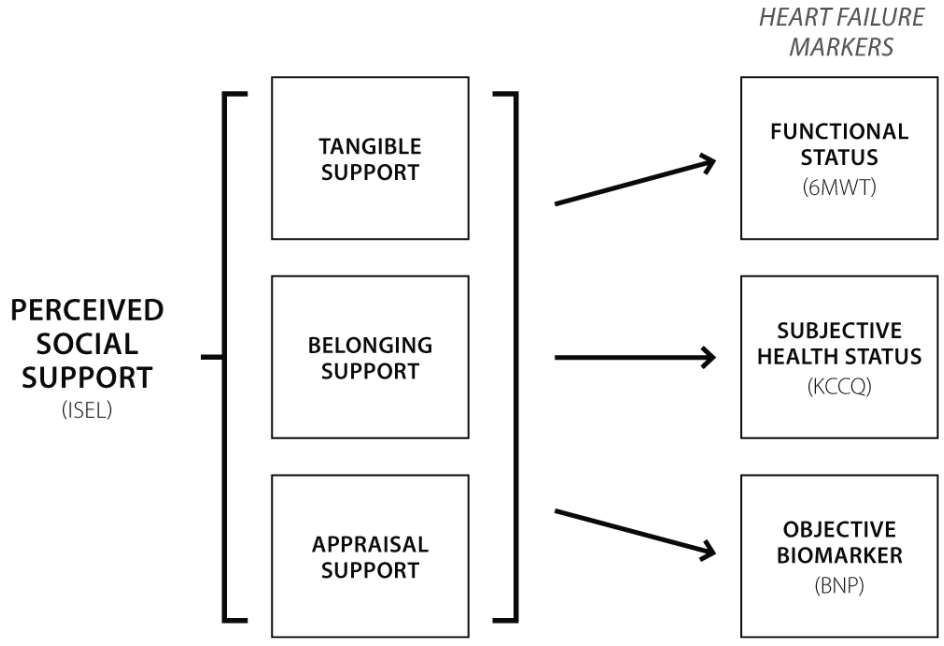

Figure 2. Conceptual model

Specific Aims and Hypotheses

Specific Aim 1: The first aim of the investigation was to determine whether the tangible support afforded by social interactions is predictive of three recognized markers of heart failure severity in a sample of heart failure patients. *It was hypothesized that greater tangible support as measured by the Tangible Subscale of the Interpersonal Support Evaluation List (ISEL) would be predictive of better health status as indicated by three markers of heart failure severity.*

Specific Aim II: The second aim of the investigation was to determine whether the appraisal support afforded by social interactions is predictive of recognized markers of heart failure severity. *It was hypothesized that greater appraisal support as measured by the Appraisal Subscale of the ISEL would be predictive of better health status among heart failure patients.*

Specific Aim III: The third aim of the investigation was to determine whether the belonging support afforded by social interactions is predictive of recognized markers of heart failure severity. *It was also hypothesized that greater belonging support as measured by the Belonging Subscale of the ISEL would be predictive of better health status.*

Specific Aim IV: The fourth aim of the investigation was to determine whether the perceived social support afforded by social interactions is predictive of recognized markers of heart failure severity. *Similarly, it was hypothesized that greater perceived social support as measured by overall scores reported on the ISEL would be predictive of better health status among heart failure patients.*

Specific Aim V: The fifth aim of the investigation was to determine whether the effects of social support on markers of heart failure severity are independent of depressive symptoms — a known risk factor for adverse cardiovascular health. *It was hypothesized that the effects of social support would be predictive of markers of heart failure severity independent of depressive symptoms.*

Methods

The present study is a cross-sectional, observational study of psychosocial and environmental factors believed to be predictive of cardiovascular outcomes in heart failure patients. Data were collected as part of an ongoing investigation funded by the National Heart, Lung, and Blood Institute (NIH Grant# 1R01 HL085730) examining biobehavioral precipitating factors of worsened heart failure. Data utilized for the present investigation was limited to information collected during the baseline phase of the study.

Study Participants

Study participants (n=97) were recruited from the Heart Failure Clinic at University of Maryland Medical Center (UMMC) in Baltimore, Maryland. Those patients deemed to be medically stable by their treating physician were eligible for study inclusion. Inclusion criteria were: (1) a diagnosis of heart failure with a New York Heart Association (NYHA) classification of II-IV for the duration of at least three months; (2) less than 40 percent left ventricular ejection fraction as assessed by echocardiogram within the previous year; (3) more than 21 years of age. Participants were excluded from participation if individuals endorsed any of the following conditions: (1) clinically significant mitral valve disease; (2) documented myocarditis in the previous 6 months; (3) alcoholism or thyroid dysfunction as the primary etiology of heart failure; (4)

implanted left ventricular assistance device; (5) planned heart transplantation; (6) active treatment for cancer; (7) residence at a nursing facility; and (8) cognitive impairments that would preclude informed consent or questionnaire completion.

Participants were instructed to maintain any current medicinal regimen as the intention of the investigation was to examine emotional precipitates of degenerating heart failure amidst usual treatment. Moreover, participants endorsing comorbid conditions (e.g., stroke, cancer) were expected given the demographic characteristics associated with heart failure diagnosis. Such patients were not excluded from the investigation unless their condition significantly interfered with study participation.

Procedures

Following a screening procedure involving an assessment of inclusion and exclusion parameters, eligible patients from UMMC presented for a baseline visit at the cardiovascular research clinic. Upon obtaining informed consent, participants completed psychosocial and physical health related questionnaires as well as provided researchers with general clinical information. A blood sample was collected in addition to measurements of heart failure symptoms and functional status. Researchers further gathered patient information related to clinical and demographic variables, current medications, resting blood pressure, and medical history in addition to conducting a thorough review of patients' medical records.

Measures

Social support. Participants also completed the Interpersonal Support Evaluation List – Short Version (ISEL-12; Cohen & Hoberman, 1983). The ISEL-12 is a self-report instrument measuring the functional components of social support that consists of 12

statements regarding the perceived availability of potential social resources. This functional support measure includes an equal number of positive and negative statements about social relationships such that the assessment is counterbalanced for desirability. Participants are instructed to endorse whether a set of statements regarding their perceived social support resources are “definitely true,” probably true,” “probably false,” or “definitely false.” Statements include, for example, “If I wanted to have lunch with someone, I could easily find someone to join me" and, “When I need suggestions on how to deal with a personal problem, I know someone I can turn to” (Cohen, Mermelstein, Kamarck, & Hoberman, 1985). The ISEL-12 represents a shortened version of the 40-item questionnaire originally developed and validated by Cohen and Hoberman (1983). Items that comprise the ISEL-12 assess three, distinct functions of social support including tangible, appraisal, and belonging resources in addition to providing an overall measure of perceived support. Specifically, the Tangible Subscale (4 items) is designed to measure the perceived availability of material aid; the Appraisal Subscale (4 items) is intended to survey the perceived availability of the presence of others with whom one can speak about problems; and the Belonging Subscale (4 items) is constructed to assess the perceived availability of persons with whom one can engage in activities (Cohen et al., 1985). Although incorporated in the original version of the ISEL, the Esteem Subscale is not included in the ISEL-12.

Regarding psychometric properties, alpha and test-retest reliability for the ISEL-40 is approximately 0.90 while internal consistency and test-retest reliabilities for the subscales range from 0.70 to 0.80. Moderate intercorrelations have also been noted between subscales (Cohen, Underwood, & Gottlieb, 2000). Moreover, confirmatory

factor analyses of the ISEL suggest that both the subscale and overall scores warrant analyses as each provide unique information for the assessment of functional social support (Brookings & Bolton, 1988). With a consistent record for demonstrating stress-buffering effects and proven adaptability among a variety of populations, the ISEL has been widely implemented throughout various domains in health-related research (Cohen et al., 2000). Although psychometric properties for the ISEL-12 have not been published to this date, the original author advocates for the utility of the shortened measure based on exploratory research (S. Cohen, personal communication, 2006).

Depressive symptoms. Following medical and clinical self-report questionnaires, participants completed the Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996). The BDI-II is a 21-item inventory that measures self-reported depressive symptoms. Participants are instructed to endorse one of four or five response choices related to the severity of depressive symptoms to include hopelessness, irritability, fatigue, appetite, and suicidal ideation. The BDI-II is a widely adopted measure applied in clinical and research settings yielding an internal consistency ranging from 0.91 to 0.93 that is highly congruent with the renowned first edition of the instrument (Beck et al., 1996; Dozois, Dobson, & Ahnberg, 1998). Psychometric findings indicate that the BDI-II is reliable and valid for assessing depression among medical patients, thereby suggesting that the instrument is applicable for the sample under investigation (Arnau, Meagher, Norris, & Bramson, 2001).

Heart failure severity outcomes.

Functional status. The Six Minute Walk Test (6MWT), developed by the American Thoracic Society (ATS), was used to measure the functional status of

participants endorsing heart failure. This straightforward, functional assessment measures the distance an individual can walk on a flat, hard surface for the duration of six minutes (ATS, 2002). According to guidelines drafted by the ATS (2002), the 6MWT provides an evaluation of global and integrated responses from cardiovascular, pulmonary, and muscular systems during exercise in determination of functional capacity and impairment. Although historically applied to assess pulmonary conditions, the 6MWT has gained acceptance for the measurement of functional status among patients with chronic heart failure (Guyatt et al., 1985). Furthermore, the safety, ease of administration, and comparability with activities of daily living has made the 6MWT a preferred choice among functional walk tests for clinical and research applications (Solway, Brooks, Lacasse, & Thomas, 2001).

Heart failure symptoms. Subjective symptom reports and general health status were assessed using The Kansas City Cardiomyopathy Questionnaire (KCCQ; Green, Porter, Bresnahan, & Spertus, 2000), a 23-item, self-administered measure that "quantifies physical limitations, symptoms, self-efficacy, social interference, and quality of life" for patients with heart failure (p. 1245). Scores on this disease-specific, health status questionnaire range from 0 to 100 with higher scores indicating better functioning (Green et al., 2000). Statements measure several subscale domains, generating scores that index physical limitations, symptom frequency, symptom burden, symptom stability, self-efficacy, quality of life, and social limitations as well as providing Clinical Summary and Overall Summary scores. The present investigation relied solely on the Overall Summary score as a measure of subjective health status given that this score incorporates all domains assessed on the KCCQ and does not threaten to complicate the interpretation

of outcomes. The KCCQ has been shown to be an extremely accurate measure of clinical change in cardiovascular health status, outperforming other widely adopted clinical assessments such as the Six Minute Walk Test (6MWT) and New York Heart Association (NYHA) classification system (Spertus, et al., 2005). Overall, the KCCQ has been shown to be a valid and reliable instrument for measuring the health status of heart failure patients that remains sensitive to both meaningful and substantial clinical changes over time (Green et al., 2000).

Physiological measurement of heart failure severity. Heart failure severity was, likewise, assessed using a physiological measurement of the biomarker β-natriuretic peptide (BNP). As previously discussed, BNP has been recognized as a valuable biomarker for the diagnosis and accurate prediction of heart failure (Dao et al., 2001; Miller et al., 2007). Blood samples were gathered from study participants during the baseline clinic visit. Samples were collected in vacuum tubes (EDTA 4.5 mmol/l), spun gently within an hour of collection, and then stored at -80 degrees Celsius until analysis. Separation of plasma was performed using a temperature-controlled centrifugation at 3000 g for 15 minutes as per quality specifications for these immunoassays (Apple et al., 2005). Prepared samples were analyzed using the Triage BNP test by laboratory personnel who were blinded to the purpose of the study.

Statistical Analyses

Univariate relationships between social support domains and heart failure outcomes were assessed using correlational analyses. Those associations found to be significant were explored for their predictive value using multiple regressions controlling for demographic and medical variables including age, gender, smoking status, body mass

index, and marital status. To address the final aim of the investigation, regression analyses were conducted to determine whether predictive relationships were maintained independent of depressive symptoms. PASW Statistics Version 18.0.3 (IBM, Chicago, Illinois) was used for all analyses.

Results

Sample Characteristics

Of the 97 individuals sampled, participants were primarily African American (64.9%) males (81.4%) with a mean age of 56.9 (± 12.0) years and generally low to middle class socioeconomic background. Patients predominantly exhibited mild to moderate heart failure severity and endorsed many common risk factors associated with heart failure. Sample characteristics including means and standard deviations are outlined in Table 2.

Predictor and Outcome Measures

Descriptive statistics. Descriptive statistics for the predictor and outcome measures revealed that participants endorsed similar rates on the social support subscales as evident by comparable means and standard deviations (Table 3). Patients sampled also reported greater overall social support on the ISEL (M = 38.0, SD = 6.5) than has been previously endorsed among patient populations sampled by the original author (M = 28.8, SD = 5.7) (Pittsburgh Mind-Body Center, 2008). Regarding the Six Minute Walk Test, the mean distance walked by patients (M = 1085.1, SD = 254.3) was lower than the 1600-1900 feet expected for healthy adults (ATS, 2002). On the KCCQ, Overall Summary scores appeared slightly higher than those previously documented for heart failure patients with an NYHA classification of II or higher (Green et al., 2000). As higher

scores on the KCCQ are indicative of better health status, these ratings suggest that participants reported less symptom burden that commonly observed in heart failure populations. Mean levels of BNP (M = 468.1, SD = 709.6) in the sample were, greater than the 100 picograms / milliliter threshold found to be the accepted level for clinical

Table 2

Sample Characteristics

Demographics		***Health***	
Sample size	97	**NYHA class** *n (%)*	
Gender *n (%)*		*II*	60 (61.9)
Male	79 (81.4)	*III*	35 (36.1)
Female	18 (18.6)	*IV*	2 (2.1)
Age *years (SD)*	56.9 (12.0)	**Medical conditions** *(%)*	
Race *n (%)*		*Coronary artery disease*	46.4 %
African American	63 (64.9)	*Hypertension*	79.2%
Caucasian	33 (34.0)	*Non-ischemic cardiomyopathy*	61.5%
North American Indian	1 (1.0)		
Highest education *n (%)*		**Ejection fraction** *M (SD)*	22.6 (7.3)
High school or less	24 (24.7)	**Health behaviors**	
High school graduate	25 (25.8)	*Current smoker (%)*	24.7%
Some college	23 (23.7)	*Smoking history (%)*	78.1%
College graduate	18 (18.6)	*Body mass index (%)*	31.1 (8.1)
Some graduate school	3 (3.1)		
Graduate degree	4 (4.1)		
Marital status *n (%)*			
Married	32 (33.0)		
Widowed	12 (12.4)		
Single	18 (18.6)		
Separated / divorced	32 (33.0)		
Household income *n (%)*			
< $15,000	32 (33.3)		
$15,000 - $30,000	24 (25.0)		
$30,000 - $70,000	31 (32.2)		
> $70,000	9 (9.4)		

diagnosis of heart failure (Maisel et al., 2002).

Outcome measures were found to be moderately correlated with one another with the exception of the relationship between subjectively reported symptoms and the physiological biomarker examined. Specifically, the 6MWT was significantly correlated with both the KCCQ (r = .38, p < .001) and BNP (r = -.30, p = .01). Subjectively reported symptoms as measured by the KCCQ, however, were not significantly correlated with the physiological biomarker BNP (r = .03, p = .82). These results indicate that measures are moderately interrelated, however, tap into distinct facets of heart failure severity.

Table 3

Descriptive Statistics

Predictors		***Outcomes***	
Interpersonal Support Evaluation List (ISEL) *score (SD)*		**Six Minute Walk Test (6MWT)** *feet (SD)*	1085.1 (254.3)
Tangible Subscale	12.8 (2.7)	**Kansas City Cardiomyopathy Questionnaire (KCCQ)** *score(SD)*	71.1 (21.4)
Appraisal Subscale	12.7 (2.6)		
Belonging Subscale	12.5 (2.6)	**β-Natriuretic Peptide**	
Total Score	38.0 (6.5)	*BNP pg/mL M (SD)*	468.1 (709.6)
		Log BNP (SD)	2.4 (0.5)

Univariate Relationships

Specific Aim I. The first aim of the investigation was to determine whether the *tangible support* afforded by social interactions was associated with three recognized markers of heart failure severity including functional status, reported symptoms, and a physiological biomarker. Given previous literature on social support and heart failure, it was hypothesized that greater tangible support as measured by the ISEL Tangible

Subscale would be associated with better health status as indicated by three markers of heart failure severity. In correlating the variables under investigation, the ISEL Tangible Subscale was not significantly related to functional status as determined by distance walked on the 6MWT (r = .03, p = .76), reported symptoms as measured by the KCCQ Overall Summary score (r = .12, p = .23), or BNP, a recognized biomarker of heart failure severity (r = -.09, p = .39).

Specific Aim II. The second aim of the investigation was to determine whether the *appraisal support* afforded by social interactions was associated with recognized markers of heart failure severity. As previously outlined, it was hypothesized that greater appraisal support as measured by the ISEL Appraisal Subscale would be associated with better health status among heart failure patients. Results revealed that the ISEL Appraisal Subscale was significantly correlated with both functional status as determined by distance walked on the 6MWT (r = .30, p = .01) and reported symptoms of heart failure as measured by the KCCQ Overall Summary score (r = .39, p < .001). The ISEL Appraisal Subscale, however, was not significantly related to BNP (r = -.08, p = .48).

Specific Aim III. The third aim of the investigation was to determine whether the *belonging support* afforded by social interactions was associated with recognized markers of heart failure severity. It was also hypothesized that greater belonging support as measured by the ISEL Belonging Subscale would be associated with better health status among sampled heart failure patients. For specific aim III, the ISEL Belonging Subscale was not significantly correlated with functional status as assessed by the 6MWT (r = .09, p = .41), reported symptoms as measured by the KCCQ Overall Summary score (r = .08, p = .42), or BNP (r = -.06, p = .58).

Specific Aim IV. The fourth aim of the investigation was to determine whether the *perceived social support* afforded by social interactions was associated with recognized markers of heart failure severity. Similarly, it was hypothesized that greater perceived social support as measured by overall scores reported on the ISEL would be associated with better health status as determined by three recognized markers of heart failure severity. Results indicated that the overall measure of perceived social support as assessed by overall scores reported on the ISEL was significantly related to subjective health status as measured by the KCCQ Overall Summary score ($r = .24$, $p = .02$); however, overall ISEL scores were not correlated with functional status as determined by the 6MWT ($r = .17$, $p = .12$) or BNP ($r = -.09$, $p = .39$).

In summary, appraisal support was significantly related to both functional status and reported symptoms of heart failure whereas the overall construct of social support was significantly correlated with reported symptoms only (see Table 4 for summary of findings). Those associations found to be significant in the initial univariate analyses

Table 4

Summary of Correlations

	Outcomes		
	Six Minute Walk Test (6MWT)	**Kansas City Cardiomyopathy Questionnaire (KCCQ)**	**β-Natriuretic Peptide (BNP)**
Interpersonal Support Evaluation List (ISEL)			
Tangible Subscale	.03	.12	-.09
Appraisal Subscale	.30**	.39**	-.08
Belonging Subscale	.09	.08	-.06
Total Score	.17	.24*	-.09

*Note: *p < .05, **p < .01, ***p < .001*

were then explored further using multivariate regression analyses controlling for demographic and biomedical variables that could affect heart failure status.

Multivariate Analyses

Covariates including age, body mass index, gender, martial status, and smoking status were selected a priori for their reported effects on outcome measures and were similarly applied in all regression analyses. Controlling for these variables, the ISEL Appraisal Subscale was significantly predictive of greater distance walked on the Six Minute Walk Test ($\beta = .31$, $p < .01$), explaining 9 percent of the variance beyond recognized predictors ($\Delta R^2 = .09$, $\Delta F\ (1, 79) = 9.48$, $p < .01$) (Table 5). When looking at reported symptoms using the same covariates, the ISEL Appraisal subscale was also

Table 5

Regression Analyses for Functional Status

	Six Minute Walk Test (6MWT)		
	B	*SE B*	β
Model 1 *(Constant)*	1543.08	278.26	
Age	-7.86	2.69	-.35**
Body mass index	-2.85	4.20	-.09
Gender	-31.53	73.43	-.05
Marital status	46.14	59.42	.09
Smoking status	16.45	67.91	.03
Model 2 *(Constant)*	1074.21	305.30	
Age	-7.26	2.57	-.33**
Body mass index	-0.81	4.05	-.03
Gender	-58.01	70.35	-.09
Marital status	64.22	56.81	.12
Smoking status	11.27	64.60	.02
ISEL Appraisal Subscale	30.35	9.86	.31**

*Note: $R^2 = .12$ for Model 1; $\Delta R^2 = .09$** for Model 2. *p < .05, **p < .01, ***p < .001*

significantly predictive of better reported health status as indicated by the KCCQ Overall Summary score (β = .39, $p < .001$), accounting for 14.1 percent of variance beyond other included predictors ($\Delta R^2 = .14$, ΔF (1, 89) = 15.60, $p < .001$) (Table 6). Examining the overall construct of perceived social support with the same covariates, the total ISEL score was also significantly predictive of better reported health status on the KCCQ (β = .27, $p = .01$), explaining 7 percent of the variance beyond recognized predictors ($\Delta R^2 = .07$, ΔF (1, 89) = 7.01, $p = .01$) (Table 7).

Table 6

Regression Analyses for Subjective Health Status

	Kansas City Cardiomyopathy Questionnaire (KCCQ) *Overall Summary Score*		
	B	*SE B*	β
Model 1 *(Constant)*	67.39	22.87	
Age	-0.11	0.21	-.06
Body mass index	-0.63	0.34	-.24
Gender	6.78	5.87	.12
Marital status	4.89	4.86	.11
Smoking status	7.69	5.73	.16
Model 2 *(Constant)*	17.24	24.72	
Age	-0.04	0.20	-.02
Body mass index	-0.43	0.32	-.16
Gender	3.52	5.51	.07
Marital status	7.54	4.56	.17
Smoking status	7.21	5.31	.15
ISEL Appraisal subscale	3.18	0.81	.39***

*Note: $R^2 = .06$ for Model 1; $\Delta R^2 = .14$*** for Model 2. *p < .05, **p < .01, ***p < .001.*
Positive scores on the KCCQ reflect better reported health status.

Table 7

Regression Analyses for Subjective Health Status

	Kansas City Cardiomyopathy Questionnaire (KCCQ) *Overall Summary Score*		
	B	*SE B*	β
Model 1 *(Constant)*	67.39	22.87	
Age	-0.11	0.21	-.06
Body mass index	-0.63	0.34	-.24
Gender	6.78	5.87	.12
Marital status	4.89	4.86	.11
Smoking status	7.69	5.73	.16
Model 2 *(Constant)*	22.80	27.82	
Age	-0.06	0.21	-.04
Body mass index	-0.56	0.33	-.21
Gender	6.18	5.69	.11
Marital status	8.46	4.89	.19
Smoking status	7.87	5.54	.16
ISEL Total Score	0.90	0.34	.27**

*Note: R^2 = .06 for Model 1; ΔR^2 = .07** for Model 2. *p < .05, **p < .01, ***p < .001.*
Positive scores on the KCCQ reflect better reported health status.

To summarize thus far, appraisal support as indicated by the ISEL Appraisal Subscale was significantly predictive of functional status and subjective health in heart failure patients independent of recognized predictors such as age, body mass index, gender, marital status, and smoking status. Overall perceived social support as measured by total scores reported on the ISEL was also significantly predictive of subjective health status independent of the same recognized predictors, although this effect is likely attributable to the inclusion of the Appraisal Support Subscale in the ISEL Total Score. In other words, having someone with whom to confide or offer resources to cope with life events was predictive of better functional health and reported symptom burden.

Social Support, Depression, and Heart Failure

Specific Aim V. Additional regression analyses were conducted to address the final aim of the investigation to determine whether the effects of social support on markers of heart failure severity were independent of depressive symptoms — a known risk factor for adverse cardiovascular health. It was hypothesized that the effects of social support would be predictive of markers of heart failure severity independent of depressive symptoms.

First, univariate correlations examined the relationship between depression and heart failure outcome variables. In these analyses, depression as measured by the BDI-II was found to be significantly correlated with distance walked on the 6MWT (r = -.26, p = .02) and reported symptoms as assessed by the KCCQ Overall Summary Score (r = -.67, p < .001); however, depression as measured by the BDI was not significantly associated with levels of BNP (r = -.03, p = .82).

Multivariate analyses. To determine whether the relationships between social support domains and heart failure outcomes remained significant independent of depressive symptoms, multivariate regression analyses were conducted. Known demographic, medical, and lifestyle risk factors were first entered into the statistical model to determine what associations emerged. Scores from the BDI-II representing reported depressive symptoms were then included as a second step in the model to account for the recognized influence of depression on heart failure outcomes. Lastly, the social support domain under investigation (i.e., Tangible Subscale, Appraisal Subscale, Belonging Subscale, or ISEL Total Score) was then included within the statistical model to determine whether the relationships between social support and markers of heart

failure severity remained significant above and beyond the influence of recognized predictors.

Tangible support. After controlling for standard biomedical predictors ($R^2 = .12$, F (5, 80) = 2.16, $p = .07$), depressive symptoms as measured by the BDI-II were significantly predictive of distance walked on the Six Minute Walk Test ($\Delta R^2 = .08$, ΔF (1, 79) = 7.75, $p = .01$). However, the inclusion of tangible support as determined by the ISEL Tangible Subscale did not significantly increase the variance explained by the model for predicting functional status ($\Delta R^2 = .01$, ΔF (1, 78) = 0.48, $p = .49$) (Table 8).

When examining subjective health status, depressive symptoms as measured by the BDI-II were also significantly predictive of reported symptoms as indicated by the KCCQ Overall Summary Scale ($\Delta R^2 = .43$, ΔF (1, 89) = 73.37, $p < .001$) beyond recognized predictors of heart failure severity in the baseline model ($R^2 = .06$, F (5, 90) = 1.07, $p = .38$). Adding the tangible support construct as measured by the ISEL Tangible Subscale, however, did not significantly increase the variance explained by the model for predicting subjective health status ($\Delta R^2 = .00$, ΔF (1, 88) = 0.20, $p = .66$) (Table 8).

In contrast, depressive symptoms as measured by the BDI-II were not significantly predictive of the biomarker BNP ($\Delta R^2 = .00$, ΔF (1, 82) = 0.03, $p = .87$) after controlling for known covariates ($R^2 = .17$, F (5, 83) = 3.41, $p = .01$). Moreover, tangible support as assessed by the ISEL Tangible Subscale did not significantly increase the variance explained by the model when examining an objective physiological measurement of heart failure severity ($\Delta R^2 = .01$, ΔF (1, 81) = 1.17, $p = .28$) (Table 8).

Table 8

Multivariate Regression Analysis for ISEL Tangible Subscale

	Six Minute Walk Test (6MWT)			**Kansas City Cardiomyopathy Questionnaire (KCCQ)** *Overall Summary Score*			**β-Natriuretic Peptide (BNP)**		
	B	*SE B*	β	*B*	*SE B*	β	*B*	*SE B*	β
Model 1 *(Constant)*	1543.08	278.26		67.39	22.87		2.53	0.53	
Age	-7.86	2.69	-.35**	-0.11	0.21	-.06	0.01	0.01	.18
Body mass index	-2.85	4.20	-.09	-0.63	0.34	-.24	-0.02	0.01	-.26*
Gender	-31.53	73.43	-.05	6.78	5.87	.12	0.09	0.14	.07
Marital status	46.14	59.42	.09	4.89	4.86	.11	-0.24	0.11	-.22*
Smoking status	16.45	67.91	.03	7.69	5.73	.16	0.11	0.14	.10
Model 2 *(Constant)*	1660.15	270.50		93.32	17.29		2.52	0.54	
Age	-8.12	2.59	-.36**	-0.22	0.16	-.12	0.01	0.01	.18
Body mass index	-1.76	4.05	-.06	-0.51	0.25	-.19*	-0.02	0.01	-.26*
Gender	-49.59	70.81	-.07	5.54	4.37	.10	0.09	0.14	.07
Marital status	42.04	57.08	.08	3.53	3.62	.08	-0.24	0.11	-.22*
Smoking status	3.97	65.37	.01	6.17	4.27	.13	0.11	0.14	.10
Beck Depression Inventory	-6.81	2.45	-.28**	-1.37	0.16	-.66***	0.00	0.01	.02
Model 3 *(Constant)*	1803.53	341.79		99.08	21.63		2.96	0.67	
Age	-8.46	2.64	-.38**	-0.23	0.16	-.13	0.01	0.01	.16
Body mass index	-1.76	4.07	-.06	-0.51	0.25	-.19*	-0.02	0.01	-.26*
Gender	-51.73	71.12	-.08	5.57	4.39	.10	0.08	0.14	.06
Marital status	28.50	60.54	.05	2.99	3.84	.07	-0.27	0.12	-.25*
Smoking status	3.53	65.59	.01	6.20	4.29	.13	0.11	0.14	.10
Beck Depression Inventory	-7.37	2.59	-.31**	-1.39	0.17	-.67***	0.00	0.01	-.01
ISEL Tangible Subscale	-7.20	10.43	-.08	-0.30	0.67	-.04	-0.02	0.02	-.12

*Note: **Six Minute Walk Test:** R^2 = .12 for Model 1; ΔR^2 = .08** for Model 2; ΔR^2 = .01 for Model 3. **Kansas City Cardiomyopathy Questionnaire:** R^2 = .06 for Model 1; ΔR^2 = .43*** for Model 2; ΔR^2 = .00 for Model 3. **β-Natriuretic Peptide (BNP):** R^2 = .17** for Model 1; ΔR^2 = .00 for Model 2; ΔR^2 = .01 for Model 3. *p < .05, **p < .01, ***p < .001. Positive scores on the KCCQ reflect better reported health status.*

Appraisal support. Multivariate regression models revealed that depression symptoms as measured by the BDI-II were significantly predictive of distance walked on the 6MWT ($\Delta R^2 = .08$, ΔF (1, 79) = 7.75, $p = .01$) after controlling for recognized predictors ($R^2 = .12$, F (5, 80) = 2.16, $p = .07$). As hypothesized, appraisal support as assessed by the ISEL Appraisal Subscale significantly increased the variance explained by the model when predicting functional status using the Six Minute Walk Test ($\Delta R^2 = .05$, ΔF (1, 78) = 4.85, $p = .03$). Interestingly, depressive symptoms were no longer significant once the ISEL Appraisal Subscale was included in the model (Table 9) suggesting that appraisal support may more important in determining distance walked on the 6MWT than depression.

After controlling for recognized predictors ($R^2 = .06$, F (5, 90) = 1.07, $p = .38$), depressive symptoms as measured by the BDI-II were significantly predictive of reported symptoms as indicated by the KCCQ Overall Summary Score ($\Delta R^2 = .43$, ΔF (1, 89) = 73.37, $p < .001$). Moreover, appraisal support as determined by the ISEL Appraisal Subscale was significantly predictive of better reported health status on the KCCQ Overall Summary Score over and above those effects imposed by depression ($\Delta R^2 = .03$, ΔF (1, 88) = 5.29, $p = .02$) (Table 9).

When examining objective markers of heart failure severity, depressive symptoms as measured by the BDI-II were not significantly predictive of BNP levels ($\Delta R^2 = .00$, ΔF (1, 82) = 0.03, $p = .87$) beyond recognized predictors of heart failure severity ($R^2 = .17$, F (5, 83) = 3.41, $p = .01$). Adding the appraisal support construct as measured by the ISEL Appraisal Subscale, likewise, did not significantly increase the variance explained by the baseline model for levels of BNP ($\Delta R^2 = .02$, ΔF (1, 81) = 1.71, $p = .20$) (Table 9).

Table 9

Multivariate Regression Analysis for ISEL Appraisal Subscale

	Six Minute Walk Test (6MWT)			**Kansas City Cardiomyopathy Questionnaire (KCCQ)** *Overall Summary Score*			**β-Natriuretic Peptide (BNP)**		
	B	*SE B*	β	*B*	*SE B*	β	*B*	*SE B*	β
Model 1 *(Constant)*	1543.08	278.26		67.39	22.87		2.53	0.53	
Age	-7.86	2.69	-.35**	-0.11	0.21	-.06	0.01	0.01	.18
Body mass index	-2.85	4.20	-.09	-0.63	0.34	-.24	-0.02	0.01	-.26*
Gender	-31.53	73.43	-.05	6.78	5.87	.12	0.09	0.14	.07
Marital status	46.14	59.42	.09	4.89	4.86	.11	-0.24	0.11	-.22*
Smoking status	16.45	67.91	.03	7.69	5.73	.16	0.11	0.14	.10
Model 2 *(Constant)*	1660.15	270.50		93.32	17.29		2.52	0.54	
Age	-8.12	2.59	-.36**	-0.22	0.16	-.12	0.01	0.01	.18
Body mass index	-1.76	4.05	-.06	-0.51	0.25	-.19*	-0.02	0.01	-.26*
Gender	-49.59	70.81	-.07	5.54	4.37	.10	0.09	0.14	.07
Marital status	42.04	57.08	.08	3.53	3.62	.08	-0.24	0.11	-.22*
Smoking status	3.97	65.37	.01	6.17	4.27	.13	0.11	0.14	.10
Beck Depression Inventory	-6.81	2.45	-.28**	-1.37	0.16	-.66***	0.00	0.01	.02
Model 3 *(Constant)*	1265.24	319.22		66.74	20.46		3.02	0.66	
Age	-7.58	2.54	-.34**	-0.17	0.16	-.10	0.01	0.01	.16
Body mass index	-0.54	3.99	-.02	-0.42	0.25	-.16	-0.02	0.01	-.28*
Gender	-64.07	69.46	-.10	4.08	4.32	.08	0.10	0.14	.08
Marital status	57.14	56.16	.11	4.93	3.59	.11	-0.26	0.12	-.24*
Smoking status	3.98	63.83	.01	6.08	4.17	.12	0.11	0.14	.09
Beck Depression Inventory	-4.65	2.58	-.19	-1.24	0.17	-.60***	0.00	0.01	-.02
ISEL Appraisal Subscale	23.15	10.51	.24*	1.54	0.67	.19*	-0.03	0.02	-.14

Note: ***Six Minute Walk Test:*** *R^2 = .12 for Model 1; ΔR^2 = .08** for Model 2; ΔR^2 = .05* for Model 3.* ***Kansas City Cardiomyopathy Questionnaire:*** *R^2 = .06 for Model 1; ΔR^2 = .43*** for Model 2; ΔR^2 = .03* for Model 3.* ***β-Natriuretic Peptide (BNP):*** *R^2 = .17** for Model 1; ΔR^2 = .00 for Model 2; ΔR^2 = .02 for Model 3. *p < .05, **p < .01, ***p < .001. Positive scores on the KCCQ reflect better reported health status.*

Belonging support. Within the domain of belonging support, results revealed that depressive symptoms as measured by the BDI-II were significantly predictive of distance walked on the 6MWT ($\Delta R^2 = .08$, ΔF (1, 79) = 7.75, $p = .01$) after controlling for known demographic and medical risk factors ($R^2 = .12$, F (5, 80) = 2.16, $p = .07$). The inclusion of belonging support, however, as assessed by the ISEL Belonging Subscale did not significantly increase the variance explained by the model for predicting functional status ($\Delta R^2 = .00$, ΔF (1, 78) = 0.21, $p = .65$) (Table 10).

For subjective health status, depressive symptoms as measured by the BDI-II were also significantly predictive of reported symptoms as indicated by the KCCQ Overall Summary Scale ($\Delta R^2 = .43$, ΔF (1, 89) = 73.37, $p < .001$) beyond recognized predictors of heart failure severity in the baseline model ($R^2 = .06$, F (5, 90) = 1.07, $p = .38$). Adding the belonging support construct as measured by the ISEL Belonging Subscale, however, did not significantly increase the variance explained by the model for predicting subjective health status ($\Delta R^2 = .00$, ΔF (1, 88) = 0.43, $p = .52$) (Table 10).

Depressive symptoms as measured by the BDI-II did not significantly predict levels of BNP ($\Delta R^2 = .00$, ΔF (1, 82) = 0.03, $p = .87$) beyond recognized predictors ($R^2 = .17$, F (5, 83) = 3.41, $p = .01$). The inclusion of belonging support as determined by the ISEL Belonging Subscale, likewise, did not significantly increase the variance explained by the model for predicting BNP ($\Delta R^2 = .02$, ΔF (1, 81) = 1.49, $p = .23$) (Table 10).

Table 10

Multivariate Regression Analysis for ISEL Belonging Subscale

	Six Minute Walk Test (6MWT)			**Kansas City Cardiomyopathy Questionnaire (KCCQ)** *Overall Summary Score*			**β-Natriuretic Peptide (BNP)**		
	B	*SE B*	β	*B*	*SE B*	β	*B*	*SE B*	β
Model 1 *(Constant)*	1543.08	278.26		67.39	22.87		2.53	0.53	
Age	-7.86	2.69	-.35**	-0.11	0.21	-.06	0.01	0.01	.18
Body mass index	-2.85	4.20	-.09	-0.63	0.34	-.24	-0.02	0.01	-.26*
Gender	-31.53	73.43	-.05	6.78	5.87	.12	0.09	0.14	.07
Marital status	46.14	59.42	.09	4.89	4.86	.11	-0.24	0.11	-.22*
Smoking status	16.45	67.91	.03	7.69	5.73	.16	0.11	0.14	.10
Model 2 *(Constant)*	1660.15	270.50		93.32	17.29		2.52	0.54	
Age	-8.12	2.59	-.36**	-0.22	0.16	-.12	0.01	0.01	.18
Body mass index	-1.76	4.05	-.06	-0.51	0.25	-.19*	-0.02	0.01	-.26*
Gender	-49.59	70.81	-.07	5.54	4.37	.10	0.09	0.14	.07
Marital status	42.04	57.08	.08	3.53	3.62	.08	-0.24	0.11	-.22*
Smoking status	3.97	65.37	.01	6.17	4.27	.13	0.11	0.14	.10
Beck Depression Inventory	-6.81	2.45	-.28**	-1.37	0.16	-.66***	0.00	0.01	.02
Model 3 *(Constant)*	1572.08	334.39		100.83	20.81		2.98	0.65	
Age	-8.10	2.60	-.36**	-0.21	0.16	-.12	0.01	0.01	.18
Body mass index	-1.77	4.07	-.06	-0.50	0.25	-.19*	-0.02	0.01	-.26*
Gender	-44.84	71.95	-.07	5.29	4.40	.10	0.07	0.14	.05
Marital status	49.61	59.77	.09	2.90	3.76	.07	-0.27	0.12	-.25*
Smoking status	7.77	66.24	.01	5.91	4.30	.12	0.11	0.14	.09
Beck Depression Inventory	-6.49	2.56	-.27*	-1.40	0.17	-.67***	0.00	0.01	-.01
ISEL Belonging Subscale	4.69	10.37	.05	-0.44	0.67	-.05	-0.03	0.02	-.13

*Note: **Six Minute Walk Test:** R^2 = .12 for Model 1; ΔR^2 = .08** for Model 2; ΔR^2 = .00 for Model 3. **Kansas City Cardiomyopathy Questionnaire:** R^2 = .06 for Model 1; ΔR^2 = .43*** for Model 2; ΔR^2 = .00 for Model 3. **β-Natriuretic Peptide (BNP):** R^2 = .17** for Model 1; ΔR^2 = .00 for Model 2; ΔR^2 = .02 for Model 3. *p < .05, **p < .01, ***p < .001. Positive scores on the KCCQ reflect better reported health status.*

Overall perceived social support. For the overall construct of perceived social support as measured by total reported scores on the ISEL, depressive symptoms as measured by the BDI-II were significantly predictive of distance walked on the Six Minute Walk Test ($\Delta R^2 = .08$, ΔF (1, 79) = 7.75, $p = .01$) after controlling for known demographic and medical predictors ($R^2 = .12$, F (5, 80) = 2.16, $p = .07$). However, the inclusion of perceived social support as assessed by total scores on the ISEL did not significantly increase the variance explained by the model for predicting functional status ($\Delta R^2 = .01$, ΔF (1, 78) = 0.59, $p = .45$) (Table 11).

When examining subjective health status, depressive symptoms as measured by the BDI-II were also significantly predictive of ISEL Total Scores as indicated by the KCCQ Overall Summary Scale ($\Delta R^2 = .43$, ΔF (1, 89) = 73.37, $p < .001$) beyond recognized predictors of heart failure severity in the baseline model ($R^2 = .06$, F (5, 90) = 1.07, $p = .38$). Adding the perceived social support construct as measured by total scores on the ISEL, however, did not significantly increase the variance explained by the model for predicting subjective health status ($\Delta R^2 = .00$, ΔF (1, 88) = 0.21, $p = .65$) (Table 11).

Moreover, depressive symptoms as measured by the BDI-II were not significantly predictive of the biomarker BNP ($\Delta R^2 = .00$, ΔF (1, 82) = 0.03, $p = .87$) after controlling for known covariates ($R^2 = .17$, F (5, 83) = 3.41, $p = .01$). The inclusion of perceived social support as determined by the ISEL Total Scores did not significantly increase the variance explained by the model when examining an objective physiological measurement of heart failure severity ($\Delta R^2 = .02$, ΔF (1, 81) = 2.26, $p = .14$) (Table 11).

Table 11

Multivariate Regression Analysis for ISEL Total Score

	Six Minute Walk Test (6MWT)			**Kansas City Cardiomyopathy Questionnaire (KCCQ)** *Overall Summary Score*			**β-Natriuretic Peptide (BNP)**		
	B	*SE B*	β	*B*	*SE B*	β	*B*	*SE B*	β
Model 1 *(Constant)*	1543.08	278.26		67.39	22.87		2.53	0.53	
Age	-7.86	2.69	-.35**	-0.11	0.21	-.06	0.01	0.01	.18
Body mass index	-2.85	4.20	-.09	-0.63	0.34	-.24	-0.02	0.01	-.26*
Gender	-31.53	73.43	-.05	6.78	5.87	.12	0.09	0.14	.07
Marital status	46.14	59.42	.09	4.89	4.86	.11	-0.24	0.11	-.22*
Smoking status	16.45	67.91	.03	7.69	5.73	.16	0.11	0.14	.10
Model 2 *(Constant)*	1660.15	270.50		93.32	17.29		2.52	0.54	
Age	-8.12	2.59	-.36**	-0.22	0.16	-.12	0.01	0.01	.18
Body mass index	-1.76	4.05	-.06	-0.51	0.25	-.19*	-0.02	0.01	-.26*
Gender	-49.59	70.81	-.07	5.54	4.37	.10	0.09	0.14	.07
Marital status	42.04	57.08	.08	3.53	3.62	.08	-0.24	0.11	-.22*
Smoking status	3.97	65.37	.01	6.17	4.27	.13	0.11	0.14	.10
Beck Depression Inventory	-6.81	2.45	-.28**	-1.37	0.16	-.66***	0.00	0.01	.02
Model 3 *(Constant)*	1473.85	363.90		86.48	22.98		3.25	0.72	
Age	-7.87	2.61	-.35**	-0.21	0.16	-.12	0.01	0.01	.16
Body mass index	-1.59	4.07	-.05	-0.50	0.25	-.19	-0.02	0.01	-.27*
Gender	-47.30	71.06	-.07	5.48	4.39	.10	0.08	0.14	.06
Marital status	55.90	60.01	.10	4.07	3.82	.09	-0.29	0.11	-.27*
Smoking status	6.88	65.65	.01	6.23	4.29	.13	0.11	0.14	.09
Beck Depression Inventory	-6.01	2.67	-.25*	-1.34	0.17	-.65***	0.00	0.01	-.03
ISEL Total Score	3.34	4.35	.09	0.13	0.28	.04	-0.01	0.01	-.17

*Note: **Six Minute Walk Test:** R^2 = .12 for Model 1; ΔR^2 = .08** for Model 2; ΔR^2 = .01 for Model 3. **Kansas City Cardiomyopathy Questionnaire:** R^2 = .06 for Model 1; ΔR^2 = .43*** for Model 2; ΔR^2 = .01 for Model 3. **β-Natriuretic Peptide (BNP):** R^2 = .17** for Model 1; ΔR^2 = .00 for Model 2; ΔR^2 = .02 for Model 3. *p < .05, **p < .01, ***p < .001. Positive scores on the KCCQ reflect better reported health status.*

In sum, multivariate results revealed that the ISEL Appraisal Subscale — but not the Tangible or Belonging Subscales — was predictive of functional status and subjective health in heart failure patients, independent of recognized predictors such as age, body mass index, gender, marital status, and smoking status. This predictive relationship of the ISEL Appraisal Subscale remained significant even after controlling for reported depressive symptoms using the BDI-II. Moreover, the overall construct of perceived social support as measured by total reported ISEL scores was also predictive of reported symptoms in heart failure patients, independent of other known predictors included in analyses. This relationship, however, was not maintained once depression as assessed by the BDI was included in the model. As the total ISEL score provides a summation of all items incorporated in the measure including statements assessing perceived appraisal support, the inclusion of the Appraisal Subscale in the ISEL Total Score may have produced these results.

Discussion

The present study examined the relationships among various components of social support and distinct markers of heart failure severity. Three functions of perceived social support to include tangible, appraisal, and belonging resources as well as the overall construct of perceived social support were explored to determine what relationships, if any, these variables shared with three recognized markers of heart failure severity (i.e., functional status, reported symptoms, and a heart failure biomarker). Univariate and multivariate analyses were conducted to address the first four aims of the investigation regarding the relationships between variables under investigation. Regarding the domains of tangible and belonging social support, the proposed hypotheses were not supported in

that the ISEL Tangible and Belonging Subscales were not significantly associated with distance walked on the 6MWT, reported symptoms on the KCCQ Overall Summary Score, or levels of BNP. As hypothesized, Appraisal Support was significantly predictive of distance walked on the 6MWT and reported symptoms using the KCCQ Overall Summary Score, although the Appraisal Subscale was not associated with levels of BNP. Furthermore, total scores reported on the ISEL — representing a summation of all support subscales — were significantly predictive of reported symptoms as indicated by the KCCQ Overall Summary Scale likely due to the inclusion of the Appraisal Subscale in the ISEL Total Score. Overall perceived social support as assessed by the ISEL Total Scores was not significantly associated with distance walked on the 6MWT and levels of BNP as predicted.

These findings for Appraisal Support suggest that having resources to cope with life events significantly influences the functional capacity and reported symptoms of heart failure patients. As measured by the Appraisal Support Subscale, perceiving access to valued others who might provide opportunities to voice concerns or could render useful information or advice seems to positively affect functional and subjective health. These results are consistent with prior findings in the literature that social support is related to and predictive of a variety of heart failure outcomes (Bennett et al., 2001; Luttik et al., 2005; Tsuchihashi-Makaya et al., 2009).

Tangible and belonging support, however, appear not to be associated with severity of heart failure outcomes. As previously noted, tangible and belonging support refer to the accessibility of others with whom to share social activities as well as resources directed toward resolving problems (Cohen et al., 2000). The finding that

appraisal support was significant while tangible and belonging support were not significant suggests that individuals with heart failure may derive greater health benefits from the availability of close confidants than simply belonging to a group or having access to material resources. This finding lends support to prior evidence observed in outcome studies for psychotherapy where individuals have been shown to benefit from having access to someone whom can help them cope with life events (Winefield, 1987).

Across all analyses, the concept of functional social support, which includes components of tangible, appraisal, and belonging resources, appears not to be correlated with the physiological biomarker BNP. There are a several possibilities why no relationship was found between functional social support and beta-natriuretic peptide (BNP). First, levels of BNP have been shown to be especially variable among heart failure patients, demonstrating within-person variability over time despite stable clinical symptoms and severity (Takeda et al., 2009). Research linking BNP to heart failure outcomes has also been mixed regarding the consistent utility of BNP for measuring changes in heart failure severity within an individual patient (Doust, Pietrzak, Dobson, & Glasziou, 2005; Hetmanski et al., 2000). For example, Hetmanski and colleagues (2000) found BNP concentrations to exhibit poor sensitivity and specificity for the accurate detection of left ventricular systolic dysfunction in a community-based sample of 1,425 heart failure patients. Furthermore, BNP may be influenced by variables not addressed in the present analyses, such as renal failure, increasing age, and cardiopulmonary diseases other than heart failure (Peacock, 2005). Although a relationship between social support and BNP was predicted, the absence of a significant correlation between levels of BNP and variables associated with heart failure is not without precedent (Ginsberg &

Topalian, 2007).

Regarding the final aim of the investigation, Appraisal Support as measured by the ISEL Appraisal Subscale remained significantly predictive of distance walked on the 6MWT and reported symptoms as indicated by the KCCQ Overall Summary Score even after accounting for recognized biological and behavioral predictors of heart failure severity including depression. Relationships between the Tangible Subscale, Belonging Subscale, and total reported scores on the ISEL were not associated with heart failure outcomes as hypothesized.

The finding that appraisal support exerts influence independent of depressive symptoms is contrary to previous evidence demonstrating that structural and functional support measures are not directly related to survival in heart failure patients endorsing depressive symptoms following myocardial infarction (Frasure-Smith et al., 2000). Specifically, Frasure-Smith and colleagues (2000) found that elevated scores on the BDI were significantly related to one-year cardiac mortality in a sample of 887 post-MI heart failure patients. Although three measures of social support including perceived social support, number of social contacts, and living with others were independently related to improvements in reported depressive symptoms over time, social support measures alone were not significantly associated with cardiac survival (Frasure-Smith et al., 2000). An interaction, however, emerged between depression symptoms reported on the BDI and perceived social support as measured by the Perceived Social Support Scale (PSSS). Depressed heart failure patients endorsing high levels of social support displayed a greater likelihood of survival from cardiac mortality as compared with those patients reporting limited social support. High levels of social support appeared to buffer against

the adverse effects of depression on one-year mortality in post-MI heart failure patients (Frasure-Smith et al., 2000). In contrast to the investigation conducted by Frasure-Smith et al. (2000), the present study relied on a cross-sectional design thereby limiting the determination of a causal relationship between social support and heart failure outcomes and likely accounting for the divergent findings.

Theoretically, appraisal support may exert influence on an individual's psychological coping processes in that access to others with whom to share worries and garner advice becomes important for managing stress reactions. According to Thoits (1986), social support can be reconceptualized as coping assistance, or "the active participation of significant others in an individual's stress-management efforts (p. 417)." Having access to social resources with whom to procure guidance can serve to eliminate or modify problematic demands such that stressors are more effectively managed. Significant others might suggest alternative means of coping with life events or participate directly in the reduction or removal of threat sources, contributing to the resilience of the stressed individual (Thoits, 1986). More effective management of stress and the strengthening of coping resources via social support may serve to indirectly improve physical and psychological health.

Results from the present investigation suggest that appraisal support may be the most important function of social support associated with heart failure severity, although questions remain through which pathway appraisal support influences heart failure disease outcomes. Returning to Uchino's (2006) model as previously reviewed, social support may work through behavioral, biological, and psychological pathways to influence disease morbidity and mortality. Social relationships may encourage more

adaptive health behaviors and adherence to medical treatments in providing access to sources of health-promoting information. Social ties may also function to promote psychological health through the strengthening of internal and external coping resources. Similarly, the availability of persons from whom one can garner advice may arouse alterations to cardiovascular, neuroendocrine, and immune systems via changes in biological reactivity to stress, thereby improving physical and psychological health (Uchino, 2006).

Study Limitations

Similar to all research endeavors, the present study was not exempt from limitations. As a cross sectional investigation, the study was not designed or able to address causality as data included in the analyses were from a single time point, thereby not permitting an examination of time order effects. Regarding variables under investigation, the study focused solely on functional social support — or the emotional, informational, instrumental, and companionship resources furnished by social contacts — as a predictor for heart failure outcomes. Despite the inclusion of marital status, structural social support, or the support generated by "the existence of and interconnections between social ties," was not explicitly addressed in the investigation (Cohen & Syme, 1985, p. 11). Social support measures were limited to results from the abridged version of the ISEL, which, although incorporating statements related to tangible, appraisal, and belonging support domains, does not include an assessment of perceived emotional support.

Likewise, the investigation does not involve a prediction of heart failure clinical events given the cross sectional nature of the design. By examining the association of

variables at a single time point, the present study acknowledges a significant relationship coupling the ISEL Appraisal Subscale with functional status and subjective heart failure outcomes, however, cannot sufficiently determine whether the presence or absence of social support predicts heart failure severity over time. Moreover, participants sampled were generally of low socioeconomic status, which has shown to be related to cardiovascular disease outcomes (Philbin, Dec, Jenkins, & DiSalvo, 2001; Rathore et al., 2006). Therefore, conclusions from the investigation are limited to the population sampled and may not generalize to a broader range of heart failure patients.

Study Strengths

Strengths of the investigation include the deconstruction of the social support construct as a means of examining the underlying functional components of social support, particularly as previous studies have focused primarily on exploring the social support construct as a whole. The study also employed a variety of clinically relevant heart failure outcomes that are demonstrated predictors of morbidity and mortality (He et al., 2001; Levy et al., 1996; Lightwood et al., 2001; Listerman et al., 2007; Lloyd-Jones et al., 2010; Kenchaiah et al., 2002; Kop et al., 2011). Further, the investigation incorporated standard risk factors in statistical analyses and also was able to determine that effects were not attributable to depression. Likewise, even though the study did not explicitly address influences of social networks, the investigation did control for marital status in an effort to account for this domain.

Clinical Implications and Future Directions

In applying these results to clinical practice, evidence from prior literature and the present investigation support the idea that comprehensive medical assessments ought to include an evaluation of social resources as support has been shown to have an impact on heart failure outcomes (Lett et al., 2005; Mookadam & Arthur, 2004; Tsuchihashi-Makaya et al., 2009). Provisionally, treatment and prevention initiatives might consider heightening components related to bolstering specific aspects of social support (e.g., supplementing resources directed toward coping with life events) in treatment approaches. Certainly, proposed programs intending to augment perceived appraisal support among heart failure patients would require further investigation to determine the effectiveness of these interventions. However, if found beneficial, these efforts may not only enhance heart failure outcomes, but could further address other psychosocial domains related to heart failure such as treatment compliance, health behaviors, and psychological well being (Das & O'Keefe, 2006; DiMatteo, 2004; Uchino, 2006).

Future research directions should also examine appraisal support longitudinally to determine if appraisal predicts, and is not simply associated with, outcomes among heart failure patients. Prospective examinations ought to incorporate a measure of structural social support as well as take into account the potential influence of perceived stress and adaptive coping resources. Research initiatives could further assess the mechanisms driving relationships between perceived social support and heart failure outcomes as well as explicitly examine through clinical trials whether appraisal can improve outcomes through applied, clinical interventions.

Conclusion

Overall, mounting evidence substantiates the beneficial influence of social support on psychological and physical health (Berkman & Syme, 1979; Cohen & Syme, 1985; Cohen et al., 1997; Holt-Lunstad et al., 2010; Uchino, 2006). The present investigation contributes further endorsement for the protective role of perceived social support on functional status and reported symptoms among heart failure patients. Research endeavors such as the aforementioned study are beginning to identify the distinct forms of social support — possibly appraisal support — that may drive the beneficial relationship between social support and heart failure severity.

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